

Eggs-periments & Eggs-plorations

Dear Educator,

The American Egg Board, together with the curriculum experts Young Minds Inspired (YMI), have teamed to bring you this **Eggs-periments and Eggs-plorations** teaching resource designed to provide integrated student learning experiences in Health and STEM education using three experiments involving eggs. In each, students will practice the scientific method as they delve into science themes, including chemistry and engineering. Students will also broaden their science vocabulary and practice evidence-based writing skills.

Please visit aeb.org/educators and the AEB's companion site, incredibleegg.org, for a host of teacher resource materials to support your health, nutrition, and science classes. Although the materials are copyrighted, you may make as many copies as needed for educational purposes.

Please comment online at ymiclassroom.com/feedback-egg-board to provide feedback. We look forward to hearing from you.

Sincerely,

Dr. Dominic Kinsley
Editor in Chief
Young Minds Inspired



For questions, contact us toll-free at 1-800-859-8005 or by email at feedback@ymiclassroom.com.

Target Audience

All activities are designed for middle school students in Health and Science classes. Activity 3 can also be used in high school classes.

Program Objectives

- Provide hands-on learning opportunities that promote student investigation and documentation of evidence.
- Integrate health and STEM education.
- Interest students in careers in food science.

Standards Alignment

This program aligns with National Health Standards, Next Generation Science Standards, National Science Standards, and Common Core State Standards for English Language Arts. For details, visit ymiclassroom.com/egg-board.

How to Use This Program

Download this teacher's guide and photocopy the activity sheets for your students. The experiment materials listed are for whole-class use. Review them and adjust the quantities for smaller group/individual use. Remind students about proper and safe use of materials.

Have students complete a hypothesis statement for each experiment based on the question and their understanding and interpretation of what the experiment outcome may be. (Responses will vary.)

Activity 1

The Incredible Chemical Egg

Materials Needed: 1 uncooked egg, rubbing alcohol, clear container, clock or timer, popsicle sticks (enough for each timed observation interval). Requires 2-3 consecutive class sessions.

Tell students that they will use the scientific method to investigate whether

the process of cooking an egg can be mimicked without using heat. When gathering data, be sure that students touch the egg with a popsicle stick (not with their hands) as they observe textural changes in the egg at various stages, being sure not to mix the white and yolk together. Discard popsicle sticks immediately after use.



Students will note that the egg white begins to turn from translucent to cloudy within a few minutes. Over time, the alcohol will continue to diffuse into the egg, mostly within the egg white, as it contains more protein than the yolk. After 24 hours the process will cause the egg to “cook,” but, since the egg yolk contains primarily fat and only a small amount of protein, it will change only slightly in texture.

Use these points to guide a class discussion in completing student observations:

- The definition of cooking is to transform by heat. In normal preparation, egg protein, or albumin (found mostly in the egg white), undergoes a chemical reaction from heat.
- The experiment illustrates *denaturing*, or the changing and rebuilding of proteins in a different way that makes the proteins within the egg undergo a chemical reaction that, in effect, “cooks” the egg.

Students' data observation should reference chemical reactions evidenced by textural changes to both egg white and egg yolk over time. Suggested conclusion: *Based on the results of the experiment, I can conclude that it is possible to create a physical change to a raw egg without using heat, because placing a raw egg in alcohol will, over time, mimic the chemical reaction that occurs in cooking through the process of denaturing.*

TO YOUR HEALTH! SECTION:

- Help students understand that too much exposure to alcohol has a detrimental effect on the body over time, causing permanent damage to body cells.
- Emphasize that the "cooked" egg in the experiment may not be safely eaten due to the formation of bacteria on the egg once it is exposed in the container. Discard the contents of the container and wash it and the workspace thoroughly with soap and water.

Encourage students to visit the **Incredible Egg** website at incredibleegg.org to find ways they may safely eat and enjoy the nutritional benefits of eggs.

Activity 2

The Incredible Volcanic Egg

Materials Needed: hard-boiled eggs, food coloring, vinegar, baking soda, large plastic plates, small paint brushes, clear plastic or glass cups or bowls, small bowl of water, measuring spoons, measuring cup, spoon, paper towels, extra paper for student experiment book. Requires 1-2 class periods.

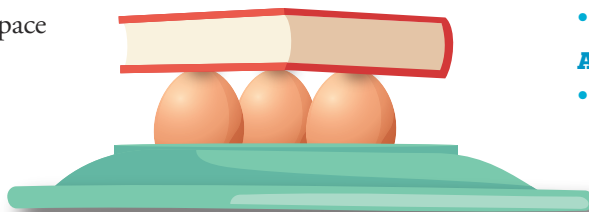


Ask students to share any personal knowledge they have of the bubbling and fizzing caused by the chemical reaction that occurs when combining an acid (vinegar) and a base (baking soda). Tell students that they will use the scientific method to investigate whether this chemical reaction will help dye an egg. Help students follow the procedure on the activity sheet to answer the question and test their hypothesis.

Student responses to the observation sentence will vary. The conclusion sentence should focus on whether or not the hypothesis was proven or disproven. Note: Dyed eggs may be peeled and eaten by students or simply thrown away. Dyed eggshells may be crushed and safely composted.

Activity 3

The Incredible Uncrushable Egg



Materials Needed: minimum of 3 raw eggs, pencil or marker, bowl, triangular file or small metal nail file or rotary motor tool with cut-off disc, large tray, hardcover book, 5-6 magazines or lightweight books. Requires 2-3 class periods, plus additional time for teacher preparation of eggs.

Prepare the eggshells ahead of class time by following the preparation steps found at "Structural Science: How Strong Are Eggshells?," at www.scientificamerican.com/article/structural-science-how-strong-are-eggshells/.

Note: You may wish to prepare additional eggs to allow for breakage during any step of the preparation process as well as during student experimentation.

Have students complete each section on the activity sheet as they conduct the experiment.

Notes on the Eggshell as a Dome:

Review this section with students to help them record details that explain the concept.

Hypothesis: Have students record the total weight they think the eggshells will support.

Book/Magazine Weights: Have students use the scale to record the weight of each book and magazine individually.

Conclusion: Ask students to write a summary of their results and discuss them as a class. Help them relate the results to the background involving the dome and the relative strength of the eggshell shape.

Resources

- ymiclassroom.com/egg-board
- American Egg Board, aeb.org
- Egg Nutrition Center, eggnutritioncenter.org
- Incredible Egg, incredibleegg.org

Activity 1

- About.com, <http://chemistry.about.com/od/foodscienceprojects/fl/How-To-Cook-an-Egg-an-Egg-With-Alcohol.htm>
- The Alcoholic Egg, www.nipissingu.ca/education/jeffs/4284Winter/PDFS/TheAlcoholicEgg.pdf

Activity 2

- Volcano Easter Egg Experiment, www.housingaforest.com/volcano-easter-egg-experiment/
- Volcano Egg Dyeing, www.toddlerapproved.com/2012/04/volcano-egg-dyeing.html

Activity 3

- Structural Science: How Strong Are Eggshells?, www.scientificamerican.com/article/structural-science-how-strong-are-eggshells/
- What Makes the Egg Shell so Strong?, www.pitara.com/science-for-kids/5ws-and-h/what-makes-the-egg-shell-so-strong/

The Incredible Chemical Egg

DO YOU THINK YOU KNOW HOW TO COOK AN EGG?

You might be surprised! Follow your teacher's directions to experiment with an egg's physical properties using chemical reactions.

QUESTION: Is it possible to cook a raw egg without using heat?

HYPOTHESIS: I think _____

_____.

Procedure

1. Pour rubbing alcohol into a clear container.
2. Crack a raw egg into the container.
3. Observe the egg at the times indicated in the data table below.
4. Use a popsicle stick to gently touch portions of the egg at each time period to better interpret changes. Do not mix the egg white and yolk.

Data Collection/Observation

Time	Description
5 minutes	
15 minutes	
24 hours	

Data Interpretation

Complete the sentences below to help interpret and reflect on your data. Use the back of this sheet if you need more room.

1. When observing changes in the egg white, I noticed _____.

When observing changes in the egg yolk, I noticed _____.

2. The data show _____.

_____.

Conclusion

Based on experiment results, I can conclude that _____.

_____.



TO YOUR HEALTH!

Consider this:

- If alcohol can “cook” an egg, what might drinking alcohol do to your body?
- Is it safe to eat the “cooked” egg in your experiment?

The Incredible Volcanic Egg

Complete the steps below with the materials supplied and follow your teacher's directions to explore how an egg can become "volcanic" through chemical reactions.

QUESTION: How can you turn an eggshell into a "volcanic" display of vibrant colors?

HYPOTHESIS: I think that _____

 _____.



PROCEDURE

1. Measure 1 tablespoon of baking soda, 2 teaspoons of water, and $\frac{1}{4}$ teaspoon of food coloring onto a plastic plate.
2. Mix ingredients into a paste using a brush, then "paint" two hard-boiled eggs with the paste mixture.
3. Place a paste-covered egg inside a clear glass or plastic cup or bowl.
4. Drop assorted food coloring colors onto the egg.
5. Pour $\frac{1}{2}$ cup of vinegar inside the glass, cup, or bowl and observe the reaction.
6. Remove the egg with a spoon and place it on the paper towel-lined plate.
7. Use different color combinations and a clean plastic cup to repeat steps 2-5 with another egg.

OBSERVATIONS AND CONCLUSION:

Include any important factors you noticed, such as the time it took for the reaction to occur, intensity of color, color pattern, etc.

I observed _____

Based on the results, I can conclude _____

Make an Incredible Volcanic Egg Experiment Book!

Cut out the procedure steps at left and glue them in order onto blank paper, adding illustrations if you wish. Cut out the Question, Hypothesis, and Observations and Conclusion sections as well, and assemble everything into a book that you can take home to share with your parents and/or use to conduct the experiment for other family members.

Don't forget: You can also peel and eat your "volcanic" hard-boiled eggs! For recipe ideas on using hard-boiled eggs, visit incredibleegg.org!



The Incredible Uncrushable Egg

HOW STRONG IS AN EGGSHELL? Follow your teacher's directions to explore the structural strength of eggshells.

QUESTION: Can empty eggshells support the weight of objects without breaking?

Notes on the Eggshell as a Dome

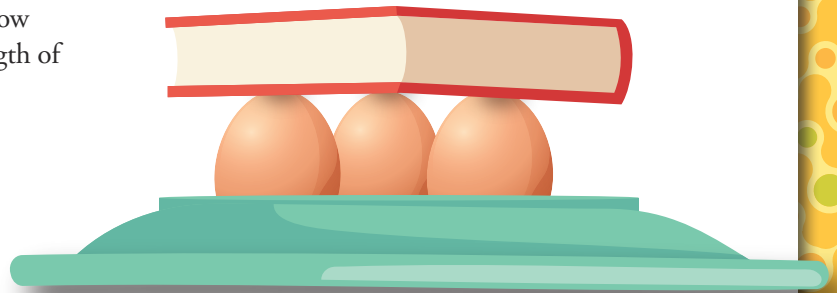
A dome, like the dome of the U.S. Capitol, distributes weight evenly around its base. This makes it much stronger than a roof that is supported by pillars. How is an eggshell like a dome?

HYPOTHESIS: I predict that the eggshells will support _____ ounces/grams before they break.

Try It

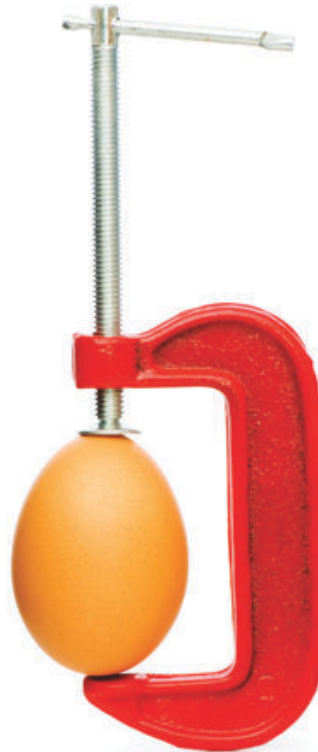
Test your hypothesis by placing three half eggshells on a flat surface in a triangle pattern. Place a hardcover book on top of the eggshells, then start piling magazines on top of the book, one at a time. Use the data chart to record the total weight the eggshells support before they break.

Description	Weight
Hardcover book	
Magazine #1	
Magazine #2	
Total weight:	



Conclusion

Record your results from the experiment. Did they support your prediction?



Eggshells are strong, but the incredible edible egg is stronger – in nutrition, that is! Just one large egg at breakfast provides 6 grams of high quality protein and helps sustain mental and physical energy throughout your day!¹ Check out incredibleegg.org to learn more.

¹All-natural, high-quality protein, like the protein in eggs, helps build muscles and allows people to feel full longer and stay energized, which can help them maintain a healthy weight. Leidy HJ, et al. Neural Responses to Visual Food Stimuli After a Normal vs. Higher Protein Breakfast in Breakfast-Skipping Teens: A Pilot fMRI Study. *Obesity*, published online May 5, 2011.
Leidy HJ, et al. Increased dietary protein consumed at breakfast leads to an initial and sustained feeling of fullness during energy restriction compared to other meal times. *B/N*, published online September 2, 2008.